REMARKS

Upon entry of this amendment Claims 1, 3, 5-6, 9-12, and 17-28 are pending and under consideration. Claims 1 and 17 are amended to more particularly claim features of the present invention. Claim 18 is canceled. Applicant respectfully submits that no new matter is added by this amendment.

Rejections under 35 U.S.C. § 102 or 35 U.S.C. 103

Claims 17-21 and 24-28 are rejected under 35 U.S.C. § 102(b) as being anticipated by Kawakami Soichiro (JP 61-37969) or in the alternative, rejected under 35 U.S.C. §103(a) as being obvious over Kawakami Soichiro (JP 61-37969). Applicant respectfully traverses this rejection, and states that the amended claims are patentable over the cited reference under both 35 U.S.C. § 102(b), or alternatively under 35 U.S.C. § 103(a).

An English translation of Kawakami Soichiro, JP 61-37969 has been previously submitted (see Amendment/Response dated October 1, 2001, in response to Office Action dated May 31, 2001). For the convenience of the Examiner, another copy is enclosed herewith.

Soichiro, on page 6, fourth paragraph of the translation, describes the apparatus of Fig. 1 and 2 as follows:

> "The space inside the cathode 1 is provided with three partitions 2, 3, and 62. The partitions have cylindrical portions and are disposed coaxially with the cathode 1. The partitions 2, 3, and 62 are fixed to the cathode support plate 4. The partition 3 is enclosed within the partition 2, and the partition 62 is enclosed within the partition 3. Buffers 18, 19, and 20 for the active reaction gas are therefore formed as described below for the spaces between the cathode 1 and partition 2, the partitions 2 and 3, and the partitions 3 and 62.
>
> A pipe 5 for feeding an active reaction gas is passed through the cathode support plate 4 coaxially with the cathode 1 and annular support 61 such that *one end portion thereof extends into the cathode 1 and*

> *opens into a tube 63.* The *tube 63 is disposed horizontally* inside the partition 62, *and the two ends thereof open into a buffer 20* mounted on the partition 62. The supply pipe 5 passes through the annular support 61, and the other end thereof is connected to a source for supplying an active reaction gas (not shown)." emphasis added.

Soichiro goes onto explain the manner of feeding an active reaction gas through the apparatus at page 7, fourth paragraph of the translation:

> " Specifically, the active reaction gas is fed via supply pipe 5 and tube 63 to the buffer 20 *through the openings at the two ends of tube 63*, filling the buffer. The active reaction gas in the buffer 20 is uniformly fed to the buffer 19 through the openings 15 in the peripheral wall of the partition 3, filling the buffer. The active reaction gas in the buffer 19 is uniformly fed to the buffer 18 through the openings 14 in the peripheral wall of the partition 2, filling the buffer. Since the openings 13, 14, and 15 are formed such that their axes do not coincide with each other, the gas admitted through the openings from a preceding buffer always impinges on the external peripheral wall surfaces of the subsequent buffer, *creating a diffusion effect* and uniformly spreading in the subsequent buffer. ..." emphasis added.

As described above, Soichiro introduces gas from <u>two ends</u> of tube 63. This is in sharp contrast to Applicant's claimed invention which introduces gas at only one end. Moreover, in Soichiro gas is introduced well within the region of the cathode 1, not at one end of the device as recited in Applicants claims. Soichiro and Applicant's claimed invention are significantly different configurations. Soichiro introduces gas within the device, and at two ends, and relies on a diffusion effect to spread the gases through the buffers. In Applicant's claimed invention, where gas is introduced at one end of an elongated tube – *i.e. where gas is introduced at a single point of entry* - it is much more difficult to achieve uniform gas flow along the substantial length of the device. Applicant respectfully submits that the Soichiro device does not consist of the features recited in Applicant's amended Claim 17.

Moreover, the specific dimensions recited in dependent claims, for example claims 24 to 28, are not taught or reasonably suggested by Soichiro. The specific parameters recited in these claims were arrived at after significant testing and experimentation, <u>over a range of operating conditions</u>. These specific parameters are not mere optimization, nor are they arrived at by routine experimentation.

Applicant respectfully contends that the amended claims are patentable in light of the cited references.

<u>Rejections under 35 U.S.C. 103</u>

Claims 1, 3, 5, 6, 9-12 and 23 are rejected under 35 U.S.C. § 103(a) as being unpatentable by Kawakami Soichiro (JP 61-37969) in view of Otsuki *et al.* (U.S. 5,474,641). Applicant respectfully traverses this rejection, and states that the amended claims are patentable over the cited references.

As discussed in detail above, Soichiro does not teach or reasonably suggest Applicant's amended claims. Applicant respectfully submits that Otsuki adds nothing more. Otsuki teaches a processing chamber provided with a mounting stand having a holder mechanism that holds an object to be processed within the processing chamber. The mounting stand is connected to a rotational mechanism and is free to rotate, and the holder mechanism is also provided with a separate, independent rotational mechanism wherein the front surface and rear surface of the object to be processed can be rotated (inverted) relative to the mounting stand (see Abstract). Otsuki does not teach or reasonably suggest, either alone or in combination, Applicant's amended claims.

Claim 22 is rejected are rejected under 35 U.S.C. § 103(a) as being unpatentable over Kawakami Soichiro (JP 61-37969) in view of Matsumoto *et al.* (U.S. 5,956,859). Applicant respectfully traverses this rejection, and states that the amended claims are patentable over the cited references.

As discussed in detail above, Soichiro does not teach or reasonably suggest Applicant's amended claims. Applicant respectfully submits that Matsumoto, either alone or in combination, does not teach or reasonably suggest Applicant's amended claims.

Matsumoto is directed to a drying apparatus for processing a surface of a substrate were a nitrogen gas is fed to a nozzle, a jet of the nitrogen gas spouted through a jet hole is generated. The jet becomes film-shaped and is projected upwardly along an inner surface of a side wall of a processing vessel. (see Abstract) . Fig. 11 of Matsumoto shows one embodiment of a nozzle. The structure of the nozzle acts as part of a drying apparatus, that is, a nozzle used as nozzles 34 and 41 for generating the jets 36 and 43 along the internal wall of the vapor filling section 31 provided in the drying apparatus 101, 102. The nozzle 67 has a double piping structure. (see column 17. lines 53 – 60).

The purpose of Matsumoto is to use nozzles to produce jets of nitrogen gas for drying. Applicant respectfully submits that there is no motivation to combine the drying nozzles of Matsumoto with the plasma CVD system of Soichiro. Assuming, *arugendo*, that one would be motivated to combine the two references, one would not arrive at Applicant's amended claims.

Based on the foregoing, Applicant submits that Claims 1, 3, 5, 6, 9-12 and 17-28 are in condition for allowance. An early indication of the same is therefore respectfully requested. If any matters can be resolved by telephone, the Examiner is invited to call the undersigned attorney at the telephone number listed below. No fees beyond those being submitted concurrently herewith are believed due. However, the Commissioner is authorized to charge any additional required fees, or credit any overpayment, to Dorsey & Whitney LLP Deposit Account No. 50-2319 (Order No. A-67178/MSS (463035-409)).

Respectfully submitted,

DORSEY & WHITNEY LLP

Maria S. Swiatek
Reg. No. 37,244

Customer No. 32940
555 California Street, Suite 1000
San Francisco, CA 94104-1513
Telephone: (650) 857-1717
Facsimile: (650) 857-1288
4817-5965-6704\1

RWS GROUP, LLC
translate.com

340 Brannan St., 5th Floor
San Francisco, CA 94107
Tel: (415) 512-8800
Fax: (415) 512-8982

COPY

TRANSLATION FROM JAPANESE

(19) JAPANESE PATENT OFFICE (JP)

(11) Unexamined Patent Application (Kokai) No. **61-37969**

(12) Unexamined Patent Gazette (A)

(51) Int. Cl.[4]:	Classification Symbols:		Internal Office Registration Nos.:
C 23 C	16/50		8218-4K
	16/24		8218-4K
H 01 L	21/205		7739-5F
	31/08		7733-5F

(43) Disclosure Date: February 22, 1986

Request for Examination: Not yet submitted

Number of Inventions: 1

(Total of 6 pages [in original])

---

(54) Title of the Invention: **Apparatus for Producing Thin Films by Plasma CVD**

(21) Application No. 59–160336

(22) Filing Date: July 31, 1984

(72) Inventor: Satoru Sugita

(72) Inventor: Atsushi Yamagami

(72) Inventor: Tatsumi Shoji

(72) Inventor: Teruhiko Furushima

(72) Inventor: Satoru Itabashi

(72) Inventor: Masaki Fukaya

(72) Inventor: Soichiro Kawakami

(71) Applicant: Canon Inc.

(74) Agent: Yoshikazu Tani, Patent Attorney

SPECIFICATION

1. Title of the Invention

Apparatus for Producing Thin Films by Plasma CVD

2. Claims

An apparatus for producing thin films by plasma CVD, comprising a reaction chamber;

a cathode disposed in the reaction chamber; and

an anode disposed in a facing arrangement with the cathode in the reaction chamber, with a reaction gas fed into the reaction chamber through a plurality of openings formed in the cathode, wherein said apparatus for producing thin films by plasma CVD is characterized in that a plurality of cells for sequentially accumulating the reaction gas are provided inside the cathode.

3. Detailed Description of the Invention

Technological Field

The present invention relates to an improvement for an apparatus for producing thin films by plasma CVD that comprises a cathode and a facing electrode provided with a substrate-holding mechanism and that is designed to produce thin films of amorphous silicon (a-Si), hydrogen (H), and the like with the aid of a plasma discharge; and more particularly to an apparatus for producing thin films by plasma CVD whose cathode has an internal structure that allows gases to be fed to the apparatus in a uniform and consistent manner.

Prior Art

Fig. 4 shows the internal structure of a conventional cathode for a plasma CVD apparatus with coaxial electrodes. In Fig. 4, 6a is a bottom that constitutes part of a

reaction chamber, 4b is an annular support whose upper portion passes through the bottom 6a and extends into the reaction chamber via an insulator 3a, and 4a is a cathode support plate fixed to the upper end of the annular support 4b. A cathode 1a is disposed inside the reaction chamber, and the lower end of the cathode 1a is fixed to the cathode support plate 4a. The cathode 1a has a cylindrical portion. A generally cylindrical partition 2c is disposed inside the cathode 1a coaxially therewith, whereby an annular space is formed between the partition 2c and the peripheral wall of the cathode 1a as a conduit 11a for the reaction gas described below.

A pipe 2a for supplying an active reaction gas is disposed inside the annular support 4b coaxially therewith, an end portion of the supply pipe 2a extends through the cathode support plate 4a into the partition 2c, and one end thereof opens into a tube 2b inside the partition 2c. The tube 2b is horizontal, and both ends thereof are fixed to the partition 2c such that they open into the conduit 11a. The other end of the supply pipe 2a is connected to a source for supplying active reaction gas (not shown).

10a is an electroconductive member one end of which opens into the cathode 1a and passes through the cathode support plate 4a via an insulator 9a, and the other end is connected to a high-frequency power supply (not shown).

The peripheral wall of the cathode 1a is provided with a plurality of gas-spraying openings 7a disposed at regular intervals in the peripheral and axial directions.

A counter electrode is disposed inside the reaction chamber at a position facing the cathode 1a. (The electrode, which is not shown, serves as a support for a substrate on which a thin film composed of a-Si or the like is to be formed by deposition.)

In this structure, the active reaction gas is fed into the reaction chamber via the supply pipe 2a, tube 2b, conduit 11a, and openings 7a; a plasma discharge is generated between the counter electrode and the cathode 1a energized by high-frequency power; the active reaction gas fed to the reaction chamber is decomposed into a plasma; and a thin film composed of a-Si, H, or the like is formed by deposition on the substrate.

However, such a conventional apparatus for producing thin films by plasma CVD has the following drawbacks. Specifically, the openings 7a (particularly those labeled "8a") formed in the peripheral wall of the cathode 1a are disposed in a facing arrangement with the openings in the two ends of the tube 2b, as shown in Fig. 4. Consequently, the active reaction gas tends to be fed into the reaction chamber directly through the two ends of the tube 2b via the openings 8a. By contrast, the active reaction gas is fed to the other openings 7a through the conduit 11a.

For this reason, more of the active reaction gas is fed through the openings 8a than through the openings 7a. As a result, the active reaction gas cannot be fed uniformly to the substrate disposed in a facing arrangement with the cathode 1a, a distribution is formed such that the plasma discharge is generated more vigorously in the peripheral area of the openings 8a, and an a-Si, H, or other thin film with a nonuniform thickness distribution is therefore formed on the substrate.

Object of the Invention

Consequently, it is an object of the present invention to overcome the shortcomings of the conventional apparatus for producing thin films by plasma CVD and to provide an apparatus for producing thin films by plasma CVD that allows an active reaction gas to be fed uniformly and consistently to a substrate supported on the counter electrode of a cathode, and a uniform thin film composed of a-Si, H, or the like to be formed on the substrate.

Aimed at attaining the stated object, the present invention entails providing the cathode interior with a plurality of cells for sequentially accumulating an active reaction gas to allow the active reaction gas to be fed uniformly (with uniform density) through all the gas-feeding openings formed in the cathode such that the active reaction gas is fed uniformly and consistently to the substrate disposed in a facing arrangement with the cathode.

Working Examples

Working examples of the apparatus for producing thin films by plasma CVD in accordance with the present invention will now be described in detail with reference to the accompanying drawings.

Fig. 1 is a fragmentary longitudinal sectional view of a working example of the apparatus for producing thin films by plasma CVD in accordance with the present invention, Fig. 2 is a fragmentary horizontal cross-sectional view thereof, and Fig. 3 is a schematic block diagram of the same working example.

In Fig. 1, 6 is a bottom that constitutes part of a reaction chamber. The upper portion of an annular support 61 passes through the bottom 6 via an insulator 8 and extends into the reaction chamber. The upper end of the annular support 61 is fixed to a cathode support plate 4. A cathode 1 having a cylindrical portion is fixed on top of the cathode support plate 4. The cathode 1 is fixed to the cathode support plate 4 coaxially with the annular support 61.

The space inside the cathode 1 is provided with three partitions 2, 3, and 62. The partitions have cylindrical portions and are disposed coaxially with the cathode 1. The partitions 2, 3, and 62 are fixed to the cathode support plate 4. The partition 3 is enclosed within the partition 2, and the partition 62 is enclosed within the partition 3. Buffers 18, 19, and 20 for the active reaction gas are therefore formed as described below for the spaces between the cathode 1 and partition 2, the partitions 2 and 3, and the partitions 3 and 62.

A pipe 5 for feeding an active reaction gas is passed through the cathode support plate 4 coaxially with the cathode 1 and annular support 61 such that one end portion thereof extends into the cathode 1 and opens into a tube 63. The tube 63 is disposed horizontally inside the partition 62, and the two ends thereof open into a buffer 20 mounted on the partition 62. The supply pipe 5 passes through the annular support 61, and the other end thereof is connected to a source for supplying an active reaction gas (not shown).

10 is an electroconductive member one end of which is connected to the partition 3, inserted into the cathode support plate 4 via an insulating member 7, and extended into the annular support 61. The other end is connected to a high-frequency power supply to allow high-frequency power to be fed from the high-frequency power supply to the cathode 1.

The peripheral wall of the cathode 1, the peripheral wall of the partition 2, and the peripheral wall of the partition 3 are provided with a plurality of respective openings 13, 14, and 15, which are fashioned to a specific diameter and are disposed at regular intervals in the peripheral and axial directions. The openings 13, 14, and 15 are shifted relative to each other to avoid a match in the axial direction. As can be seen in Fig. 2, the openings 15 in the partition 3 are disposed away from the axial extension of the tube 63.

An active reaction gas can be fed to the reaction chamber in the following manner with the aid of the above-described inventive apparatus for producing thin films by plasma CVD.

Specifically, the active reaction gas is fed via the supply pipe 5 and tube 63 to the buffer 20 through the openings at the two ends of the tube 63, filling the buffer. The active reaction gas in the buffer 20 is uniformly fed to the buffer 19 through the openings 15 in the peripheral wall of the partition 3, filling the buffer. The active reaction gas in the buffer 19 is uniformly fed to the buffer 18 through the openings 14 in the peripheral wall of the partition 2, filling the buffer. Since the openings 13, 14, and 15 are formed such that their axes do not coincide with each other, the gas admitted through the openings from a preceding buffer always impinges on the external peripheral wall surfaces of the subsequent buffer, creating a diffusion effect and uniformly spreading in the subsequent buffer. Consequently, the active reaction gas is uniformly and consistently ejected outside the peripheral wall of the cathode 1 through the openings 13 in the peripheral wall of the cathode 1. The preceding/subsequent ratio for the diameters of the openings 13, 14, and 15 should be kept between 10:1 and 3:1.

When, for example, a conventional apparatus for producing thin films by plasma CVD (Fig. 4) is used, the thin film formed by deposition on a substrate whose dimension in the longitudinal direction is 300 mm has a thickness distribution such that a thickness difference of ±15% is observed in the longitudinal direction. By contrast, using a working example of the present invention (Figs. 1, 2, and 3) yields a thickness distribution in which the thickness difference in the longitudinal direction is reduced to no more than ±5% for a thin film formed by deposition on a substrate with the same dimensions as those described above under the same film-forming conditions as those described above.

In Fig. 3, 21 is a reaction chamber; 23 is a cathode provided such that it extends into the reaction chamber 21 via an insulator 25B; 22 is a counter electrode that is disposed in a facing arrangement with the cathode 23 inside the reaction chamber, is supported by an appropriate support means, and is grounded by an electroconductive member 66 connected by being passed through the ceiling of the reaction chamber via an insulator 25A; 24 is a substrate mounted on the inside of the counter electrode and used for forming a thin film composed of a-Si, H, or the like by deposition; 64 is an exhaust system connected to the reaction chamber; 64[1] is a reaction gas system for feeding an active reaction gas to the cathode 23; and 65 is a power supply system for supplying high-frequency power to the cathode 23.

Fig. 5 is a fragmentary longitudinal sectional view depicting another apparatus for producing thin films by plasma CVD in accordance with the present invention, and Fig. 6 is a schematic block diagram of this apparatus. The apparatus for producing thin films by plasma CVD is a horizontal-plate device, as shown in Fig. 5. In Fig. 5, 34 is a bottom that constitutes part of a reaction chamber and has a through hole 34A. An annular support 67 is fixed to the lower surface of the bottom 34a[2] around the through hole 34A. A cathode support plate 50 is fixed to the upper surface of the bottom 34 via an

[1] Translator's note: It appears that the same symbol is used in the original to designate two different units.
[2] Translator's note: Referred to hereinabove as "bottom 34."

The above-described structure allows an active reaction gas to be fed to the substrate 44 in a uniform and consistent manner. Specifically, the buffer 53 is filled with the active reaction gas via the supply pipe 37, the buffer 52 is filled via the openings 41, the buffer 51 is filled via the openings 40, and the active reaction gas is fed to the substrate 44 via the openings 39 in a uniform and consistent manner.

In Fig. 6, 68 is a reaction chamber, 31 is a cathode disposed inside the reaction chamber 68, 42 is a counter electrode disposed in a facing arrangement with the cathode 31 inside the reaction chamber 68, 44 is a substrate mounted on the counter electrode 42, 48 is an electroconductive member for grounding the counter electrode 42, 69 is a discharge system connected to the reaction chamber, 70 is a reaction gas system for feeding the reaction gas to the cathode 31, and 71 is a power supply system for supplying high-frequency power to the cathode.

Merits of the Invention

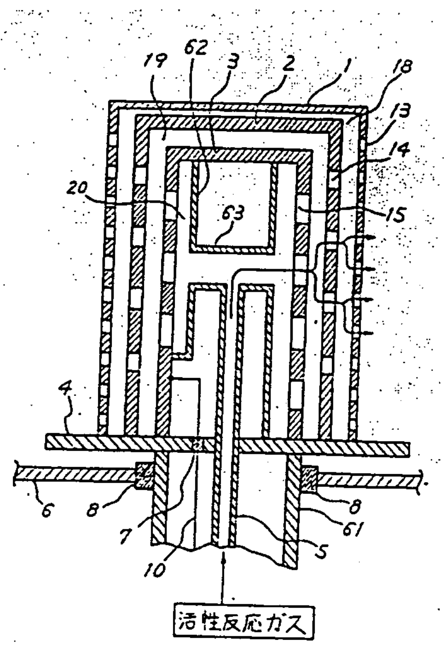
According to the invention described above, an active reaction gas can be fed in a uniform and consistent manner through the entire portion facing the counter electrode of a cathode, making it possible to form a uniform plasma discharge across the entire substrate and to cover the substrate with a thin film consisting of a-Si, H, or the like and having a uniform thickness distribution.

4. **Brief Description of the Drawings**

Fig. 1 is a fragmentary longitudinal sectional view of a working example of the apparatus for producing thin films by plasma CVD in accordance with the present invention, Fig. 2 is a fragmentary horizontal cross-sectional view of the apparatus, Fig. 3 is a schematic block diagram of the apparatus, Fig. 4 is a fragmentary longitudinal sectional view of a conventional apparatus for producing thin films by plasma CVD, Fig. 5 is a fragmentary longitudinal sectional view of another working example of the apparatus for producing thin films by plasma CVD in accordance with the present invention, and Fig. 6 is a schematic block diagram of the apparatus.

1, 31: cathodes; 2, 3, 32, 33, 62: partitions; 13, 14, 15, 39, 40, 41: openings; 18, 19, 20, 51, 52, 53: buffers; 22, 42: counter electrodes; 21, 68: reaction chambers

Fig. 1



Key to figure: Active reaction gas

Fig. 2

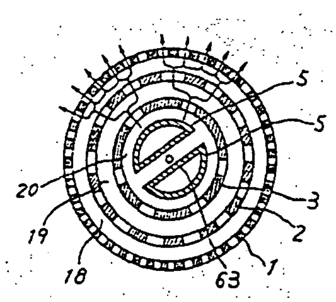
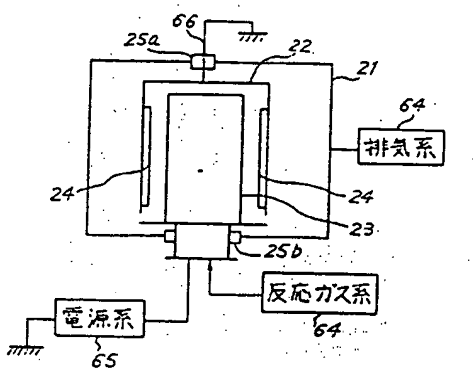


Fig. 3



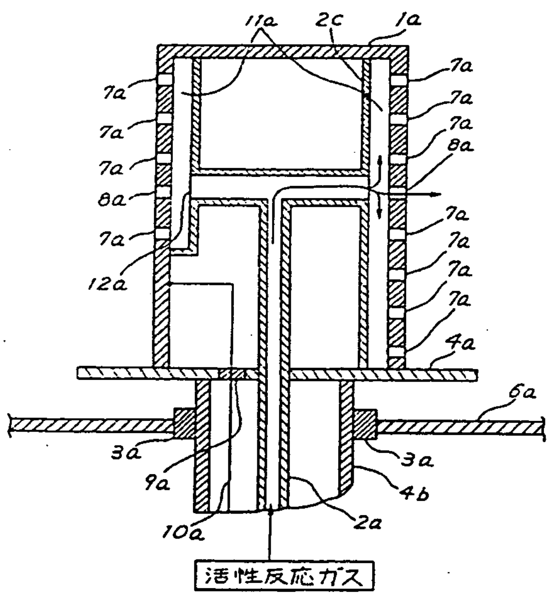
Key to figure:

64: exhaust system

64: reaction gas system

65: power supply system

Fig. 4



Key to figure:

Active reaction gas

Fig. 5

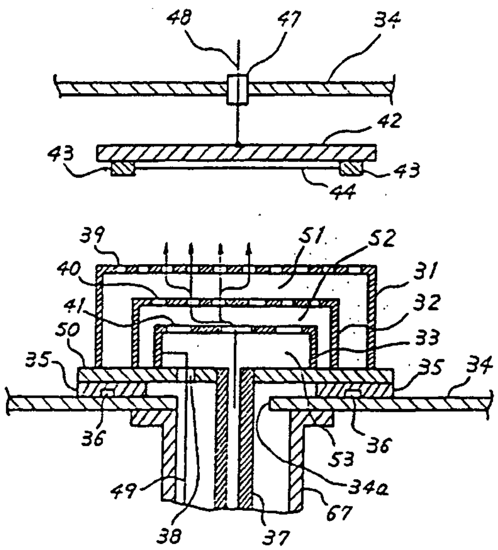
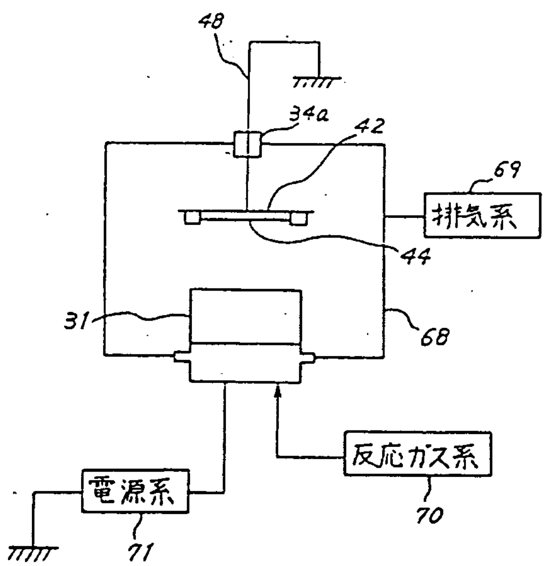


Fig. 6



Key to figure:

69: exhaust system

70: reaction gas system

71: power supply system

RWS Group, LLC

Multilingual Communications and Global Management of Language-Related Projects

340 Brannan Street, Fifth Floor, San Francisco, CA 94107 Tel: (415) 512-8800 Fax: (415) 512-8982

REQUEST FROM: ______________________ **ATTENTION:** ______________________
Company RWS Project Manager

REQUESTED BY:

____
Name
____
Department
____
Street Address
____
City State Zip
____
Phone Fax

APPX. # OF PAGES: ______________________
DATE:
____
MY REFERENCE: ______________________
TITLE: ______________________
____
____

Translation:
- ❑ Translate
- ❑ Estimate the enclosed document
- ❑ Order* and translate the requested document
- ❑ Order* document only
- ❑ Order* and estimate document

($35 document delivery charge per document. Volume discounts available - call for information)

Turnaround Time:
- ❑ Standard / 10 business days
- ❑ Rush / 5 business days (surcharges may apply)
- ❑ Other (please specify): ______________________

____

Delivery:
- ❑ First Class Mail ❑ Messenger
- ❑ Overnight Express ❑ Fax
- ❑ Electronic Mail

____
- ❑ Text File ❑ Insert ❑ Attachment
- ❑ Charge to me express carrier

Acc't No. ______________________

Carrier: ______________________

Software Environment of Original:
❑ MAC ❑ WIN ❑ DOS ❑ N/A
Application: ______________________

Deliverables:
- ❑ Deliver in hard copy
- ❑ Deliver in electronic format

software: ______________________
- ❑ Please deliver both

Purpose:
- ❑ Informational ❑ Filing ❑ Litigation
- ❑ Other: ______________________

Formatting:

Tables
❑ Key ❑ Cut & Paste ❑ Reproduce

Figures
❑ Key ❑ Cut & Paste

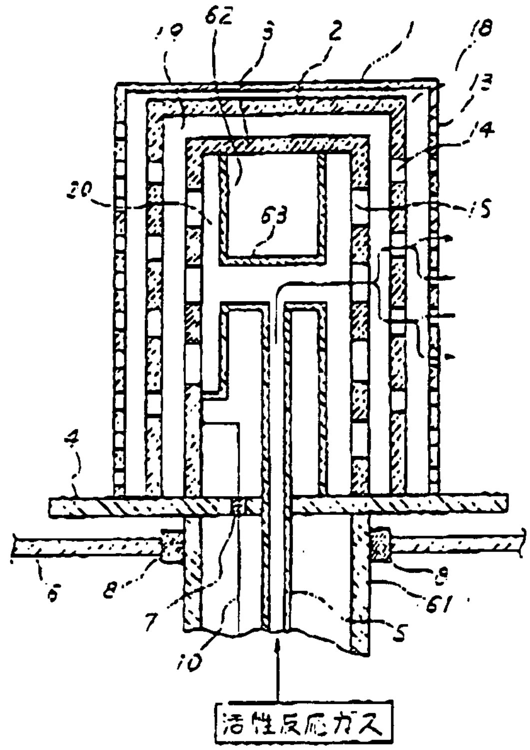
Special Instructions:

____
____
____
____
____
____

If you have any additional questions or requests, please call us at 800-829-7700.

EUROPEAN PATENT OFFICE

Patent Abstracts of Japan



PUBLICATION NUMBER : 61037969
PUBLICATION DATE : 22-02-86

APPLICATION DATE : 31-07-84
APPLICATION NUMBER : 59160336

APPLICANT : CANON INC;

INVENTOR : KAWAKAMI SOICHIRO;

INT.CL. : C23C 16/50 C23C 16/24 H01L 21/205
H01L 31/08

TITLE : PLASMA CVD DEVICE FOR MANUFACTURING THIN FILM

ABSTRACT : PURPOSE: To supply stably a reaction gas and to form a uniform thin film by providing plural chambers in a cathode which is opposed to an anode provided in a reaction chamber and has plural ejection ports, and retaining successively the reaction gas in each chamber.

CONSTITUTION: A cathode supporting plate 4 is fixed to the upper end of an annular strut 61 which is pierced through the bottom wall 6 of a reaction chamber and fixed to the wall 6 through an insulating material 8 in the reaction chamber of a plasma CVD thin film-forming device, and a cathode 1 is opposed to an anode (not shown in the figure) and fixed on the supporting plate 4. Partition wall 2, 3, and 62 having a cylindrical part are successively provided concentrically in the cathode 1 to form buffers 18, 19, and 20 in the space between said partition walls. An active reaction gas is supplied into a horizontal pipe 63 in said partition wall 62 through a supply pipe 5, passed through plural ports 14 and 15 provided to the peripheral wall of the partition walls 2 and 3, and then passed through said buffers 18, 19, and 20 while being retained in each buffer. Consequently, the reaction gas is supplied stably and uniformly into the anode from a port 13 of the peripheral wall of the cathode 1.

⑲日本国特許庁（JP）　　⑪特許出願公開

⑫公開特許公報（A）　　昭61-37969

⑸Int.Cl.⁴　識別記号　庁内整理番号　㊸公開　昭和61年（1986）2月22日

Int.Cl.		識別記号	庁内整理番号
C 23 C	16/50		8216-4K
	16/24		8216-4K
H 01 L	21/205		7739-5F
	31/08		7733-5F

審査請求　未請求　発明の数　1　（全6頁）

㊿発明の名称　プラズマCVD薄膜製造装置

㉑特　願　昭59-160336
㉒出　願　昭59（1984）7月31日

㉒発明者　杉田　哲　東京都大田区下丸子3丁目30番2号　キヤノン株式会社内
㉒発明者　山上　敦士　東京都大田区下丸子3丁目30番2号　キヤノン株式会社内
㉒発明者　庄司　辰美　東京都大田区下丸子3丁目30番2号　キヤノン株式会社内
㉒発明者　吉島　輝彦　東京都大田区下丸子3丁目30番2号　キヤノン株式会社内
㉒発明者　板橋　哲　東京都大田区下丸子3丁目30番2号　キヤノン株式会社内
㉒発明者　深谷　正樹　東京都大田区下丸子3丁目30番2号　キヤノン株式会社内
㉒発明者　川上　総一郎　東京都大田区下丸子3丁目30番2号　キヤノン株式会社内
㉑出願人　キヤノン株式会社　東京都大田区下丸子3丁目30番2号
㉔代理人　弁理士　谷　義一

明細書

1. 発明の名称

プラズマCVD薄膜製造装置

2. 特許請求の範囲

反応室と、

該反応室内に設けたカソードと、

前記反応室内に設けられ、前記カソードに対向したアノード電極とを有し、前記カソードに形成した複数の孔から前記反応室内に反応ガスを噴出するプラズマCVD薄膜製造装置において、

前記カソード内に、反応ガスを順次拡散させる複数の隔壁を設けたことを特徴とするプラズマCVD薄膜製造装置。

（以下余白）

3. 発明の詳細な説明

〔技術分野〕

本発明は、カソードと、これに対向しかつ基板保持機構をもつ電極とを備え、プラズマ放電を利用してアモルファスシリコン（a-Si）等の薄膜を製造するプラズマCVD薄膜製造装置の改良に関し、特にこの種の装置において、安定した一様なガス供給を可能にする内部構造を有するカソードを用いたプラズマCVD薄膜製造装置に関するものである。

〔従来技術〕

平行平板電極をもつプラズマCVD装置の従来のカソードの内部構造を第4図に示す。第4図において、4aは反応室の一部を構成する底壁、4bは絶縁物4cを介して底壁4aを貫通しその上部が反応室内に突出した管状支持体、4dは管状支持体4bの上端に固定されたカソード支持板である。反応室内にはカソード1aが設けられ、このカソード1aの下端がカソード支持板4dに固定されている。カソード1aは中空部分を有する。カソード1aの内部にはこれ

カソード支持板50の上面には、環状支柱67と同軸上に、筒状部分を有するカソード31が固定され、さらにこのカソード31内に位置するように、かつカソード31と同軸上に筒状部分を有する2つの隔壁32および33が固定されている。隔壁33は隔壁32の内側に配置されている。

カソード31の上壁、隔壁32の上壁および隔壁33の上壁には、その全面にわたるように各々複数個の孔39,40および41が形成されている。各孔39,40および41は、その位置が一致しないように各々配置されている。

環状支柱67内には活性反応ガスの供給パイプ37が通っており、供給パイプ37の一端はカソード支持板50に取付けられ、かつ隔壁33の内側空間に開口している。カソード31と隔壁32との間の空間、隔壁32と33との間の空間および隔壁33の内側の空間は、反応ガスのバッファ51,52および53を各々形成する。

49は導電部材であって、その一端は隔壁33に接続され、絶縁物38を介してカソード支持板50を貫

通し、さらに環状支柱67内を通り、図示しない高周波電源に他端が接続されている。42は反応室内に設けられた対向電極であって図示しないが適当な支持手段によって支持されてカソード31の上方にカソード31に対向するようにかつカソード31の上壁と平行になるように配置されている。44は対向電極42の下側に基板保持機構43を介して支持された基板である。48は導電部材であって、一端が対向電極に接続され絶縁物47を介して反応室の一部を構成する天井壁34を貫通し、他端がアースされている。

以上のような構成によっても、基板44に対し、活性反応ガスを安定かつ均一に供給することができる。すなわち供給パイプ37を介して活性反応ガスはバッファ53内に充満し、孔41を介してバッファ52内にまんべんなく充満し、孔40を介してバッファ51内にまんべんなく充満し、そして孔39から基板44に安定かつ均一に活性反応ガスが噴出される。

第6図において69は反応室、31は反応室68内に

設けられたカソード、42は同じく反応室68内にカソード31と対向するように設けられた対向電極、44は対向電極42に取付けられた基板、48は対向電極42をアースするための導電部材、80は反応室に接続された排気系、70はカソード31内に反応ガスを供給するための反応ガス系、71はカソードに高周波電力を供給するための電源系である。

〔効果〕

以上説明したように本発明によれば、カソードの対向電極と対向した部分の全体から安定にかつ一様に活性反応ガスを噴出することができ、したがって基板に対してその全体にわたって均一なプラズマ放電を形成することができ、その結果均一な膜厚分布を持つa-Si:H等の薄膜を基板上に堆積形成することができる。

4. 図面の簡単な説明

第1図は本発明にかかるプラズマCVD薄膜製造装置の一実施例の要部を示す垂直断面図、

第2図は同装置の要部の水平断面図、

第3図は同装置の概略構成を示す図、

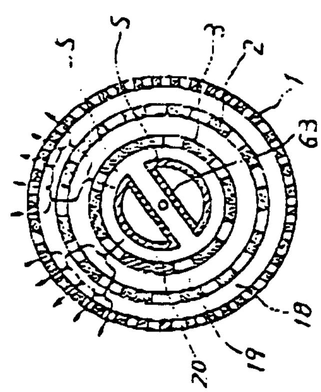
第4図は従来のプラズマCVD薄膜製造装置の要部の垂直断面図、

第5図は本発明にかかるプラズマCVD薄膜製造装置の他の実施例の要部を示す垂直断面図、

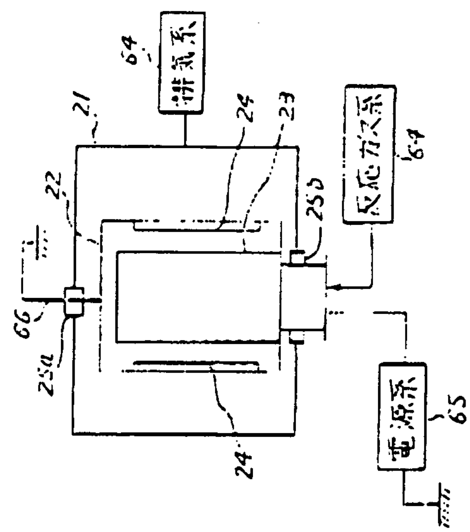
第6図は同装置の概略構成図である。

1,31…カソード、
2,3,32,33,62…隔壁、
13,14,15,39,40,41…孔、
18,19,20,51,52,53…バッファ、
22,42…対向電極、
21,69…反応室。

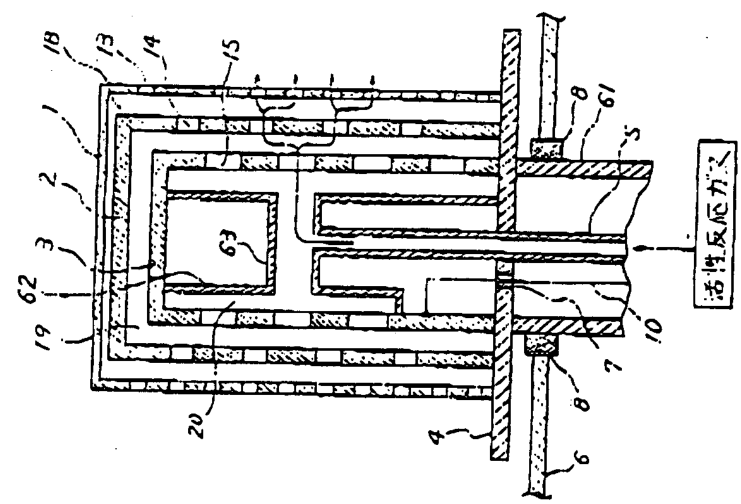
第 2 図


5
5
3
2
1
63
18
19
20

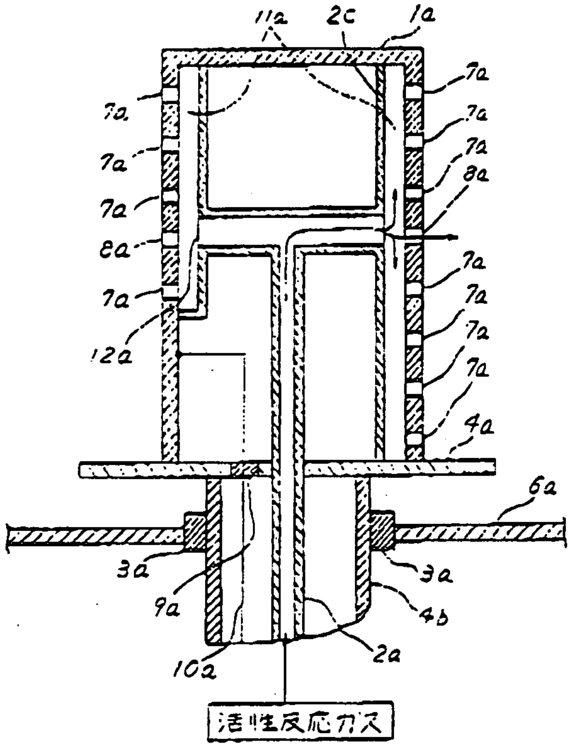
第 3 図


排気系
64
21
22
24
23
25b
反応ガス系
64
66
25a
電源系
65
24

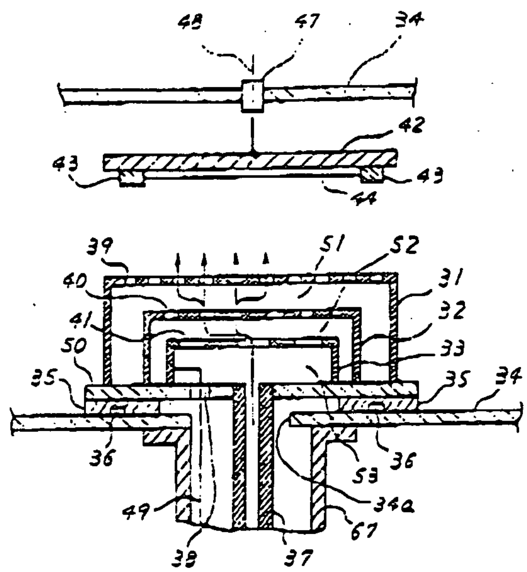
第 1 図


18
13
14
15
1
2
3
62
19
63
20
4
8
61
5
7
10
8
6
活性反応ガス

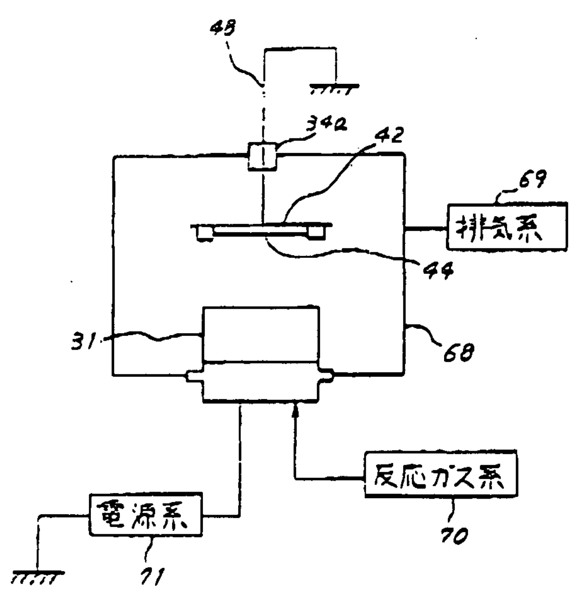
第 4 図


11a
2c
1a
7a
8a
12a
4a
6a
3a
9a
4b
10a
2a
活性反応ガス

第 5 図


48
47
34
42
43
44
39
51
52
40
31
32
41
33
50
35
36
53
34a
49
67
38
37

第 6 図


48
34a
42
69
排気系
44
31
68
反応ガス系
電源系
70
71